

U. S. DEPARTMENT OF COMMERCE
CIVIL AERONAUTICS ADMINISTRATION
WASHINGTON 25, D. C.

TECHNICAL STANDARD ORDER
Regulations of the Administrator
Part 514

SUBJECT: Carbon Monoxide Detector Instruments

TSO-C48

Part 514--Technical Standard Orders for Aircraft Materials,
Parts, Processes, and Appliances

Under section 601 of the Civil Aeronautics Act of 1938 and the delegation of authority from the Civil Aeronautics Board in §§ 3.18, 4a.31, 4b.18, 6.18, and 7.18 of the Civil Air Regulations, the Administrator of Civil Aeronautics is authorized to adopt performance standards and specifications of materials, parts, processes, and appliances used in aircraft as he may find necessary to implement provisions of the Civil Air Regulations. The Administrator adopted the Technical Standard Order system as a means to carry out this delegated authority. This system, in brief, provides for CAA-industry cooperation in the development of these performance standards, and a form of self-regulation by industry in demonstrating compliance with these standards. Since the original adoption of this part, which contains the C series TSO's, it has been found desirable to make clarifying editorial and format changes. Hence, Part 514 of the Regulations of the Administrator is being amended to provide two subparts. Subpart A contains the general requirements applicable to all Technical Standard Orders, such as "Method of Conformance," "Marking," and "Deviations." Subpart B contains the technical specifications to which a specific product must conform.

SUBPART A--GENERAL

§ 514.1 *Basis and purpose*—(a) *Basis*. Section 601 of the Civil Aeronautics Act of 1938, as amended, and §§ 3.18, 4a.31, 4b.18, 6.18, 7.18 of the Civil Air Regulations.

(b) *Purpose*. The purpose of this part is to establish minimum performance standards for aircraft materials, parts, processes, and appliances which are to be used on civil aircraft of the United States, and to prescribe the manner by which the manufacturer must show compliance with such performance standards.

§ 514.2 *Method of conformance*. A manufacturer of an aircraft material, part, process, or appliance for which standards are established in Subpart B of this part, prior to distribution for use on a civil aircraft of the United States, shall furnish a written statement of conformance certifying that the material, part, process, or appliance meets the applicable performance standards established in this part. The statement of conformance shall be signed by a person duly authorized by the manufacturer, and shall be furnished to the Chief, Aircraft Engineering Division, Office of Aviation Safety, Civil Aeronautics Administration, Washington 25, D. C.

If complaints of nonconformance with the requirements of this Order are brought to the attention of the CAA and investigation indicates that such complaints are justified,

the Administrator will take appropriate action to restrict the use of the product in civil aircraft.

§ 514.3 *Marking*. Materials, parts, processes, and appliances for which a statement of conformance has been submitted, shall be legibly and permanently marked with the following information:

(a) Name and address of the manufacturer responsible for compliance,

(b) Equipment name, or type or model designation,

(c) Weight to the nearest pound and fraction thereof,

(d) Serial number and/or date of manufacture, and

(e) Applicable Technical Standard Order (TSO) number.

§ 514.4 *Deviations*. No deviation will be granted from the performance standards established in Subpart B. Requests for deviation from other requirements of this part should be addressed to the Aircraft Engineering Division, Office of Aviation Safety, Civil Aeronautics Administration, Washington 25, D. C.

Technical Standard Orders are obtainable without charge from the CAA, Special Services Division, Inquiry Unit, Washington 25, D.C.

SUBPART B

§514.47 Carbon monoxide detector instruments--TSO-C48--(a) Applicability--(1) Minimum performance standards. Minimum performance standards are hereby established for carbon monoxide detector instruments which specifically are required to be approved for use in civil aircraft of the United States. New models of carbon monoxide detector instruments manufactured for installation in civil aircraft on or after October 15, 1957, shall meet the standards set forth in SAE Aeronautical Standard AS-412A, "Carbon Monoxide Detector Instruments," dated December 15, 1956.¹ Carbon monoxide detector instruments approved by the Civil Aeronautics Administration prior to October 15, 1957, may continue to be manufactured under the provisions of their original approval.

(b) Marking. In lieu of the weight specified in paragraph (c) of §514.3, the rating shall be shown.

(c) Data requirements. One copy each of the manufacturer's operating instructions, schematic diagrams, and installation procedures shall be furnished the Chief, Aircraft Engineering Division, Civil Aeronautics Administration, Washington 25, D. C., with the statement of conformance.

(d) Effective date. October 15, 1957.

¹ Copies may be obtained from the Society of Automotive Engineers, 485 Lexington Avenue, New York 17, New York.

CARBON MONOXIDE DETECTOR INSTRUMENTS

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Revised 12-15-56

1. **PURPOSE:** To specify minimum requirements for carbon monoxide detector instruments for use in aircraft, the operation of which may subject the instrument to the environmental conditions specified in Paragraph 3.3. This standard is not intended to cover fire detectors.
2. **SCOPE:** This Aeronautical Standard covers the basic type of carbon monoxide detector instrument used to determine toxic concentrations of carbon monoxide by the measurement of heat changes through catalytic oxidation.
3. **GENERAL REQUIREMENTS:**
 - 3.1 **Material and Workmanship:**
 - 3.1.1 **Materials:** Materials shall be of a quality which experience and/or tests have demonstrated to be suitable and dependable for use in aircraft instruments.
 - 3.1.2 **Workmanship:** Workmanship shall be consistent with high grade aircraft instrument manufacturing practice.
 - 3.2 **Identification:** The following information shall be legibly and permanently marked on the instrument or attached thereto:
 - (a) Name of instrument (Carbon Monoxide Detector)
 - (b) SAE Aeronautical Standard AS412A
 - (c) Manufacturer's part number
 - (d) Manufacturer's serial number or date of manufacture
 - (e) Manufacturer's name and/or trademark
 - (f) Rating
 - 3.3 **Environmental Conditions:** The following conditions have been established as design requirements only. Tests shall be conducted as specified in Sections 5, 6, and 7.
 - 3.3.1 **Temperature:** When installed in accordance with the instrument manufacturer's instructions, the instrument shall function over the range of ambient temperature indicated in Column A below, and shall not be adversely affected by exposure to the temperatures shown in Column B below.

Instrument Location	A	B
Heated Areas (Temp. controlled)	-30 to 50 C	-65 to 70 C
Unheated Areas (Temp. uncontrolled)	-55 to 70 C	-65 to 70 C
 - 3.3.2 **Humidity:** The instrument shall function and shall not be adversely affected when exposed to any relative humidity in the range from 0 to 95 percent at a temperature of approximately 32 C.
 - 3.3.3 **Altitude:** The instrument shall function and not be adversely affected when subjected to a pressure and temperature range equivalent to -1000 feet to 40,000 feet standard altitude except that the instrument temperature shall not be lower than -30 C.

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- 3.3.4 Vibration: When installed in accordance with the instrument manufacturer's instructions, the instruments shall function and shall not be adversely affected when subjected to vibrations of the following characteristics:

<u>Type of Instrument Mounting</u>	<u>Cycles/Min</u>	<u>Max. Double Amplitude</u>	<u>Maximum Acceleration</u>
Airframe Structure Mounted	300 - 30,000	.036"	10g
Shock Mounted Panel or Shock Mounted Rack	300 - 3,000	.020"	1.5g

4. DETAIL REQUIREMENTS:

- 4.1 Design: The instrument shall consist of a means for testing air for contamination with carbon monoxide. It shall include an alarm circuit or control circuit which will indicate the presence of contamination when it reaches a concentration between .005 and .007 per cent of carbon monoxide by volume.
- 4.1.1 Sampling Method: A means shall be incorporated in the design to direct the air sample to the sensitive element of the instrument in a positive manner.
- 4.2 Indicating Method: The instrument shall be capable of actuating both visual and aural alarm indicators.
- 4.3 Reliability: False signals (including failure) in the instrument shall not result from variations in flight attitude, from normal amounts of gasoline vapors and dust likely to accumulate in the instrument in normal flight operations, from accelerations encountered in flight or landing, or from variations in voltage (+25 per cent, -100 per cent of the rated).
- 4.4 Power Variations: All units shall properly function with +10 per cent -20 per cent variation in DC voltage and/or \pm 10 per cent variation in AC voltage and \pm 5 per cent variation in frequency.

5. TEST CONDITIONS:

- 5.1 Atmospheric Conditions: Unless otherwise specified, all tests required by this Aeronautical Standard shall be conducted at an atmospheric pressure of approximately 29.92 inches of mercury and at an ambient temperature of approximately 22 C. When tests are conducted with the atmospheric pressure or the temperature substantially different from these values, allowance shall be made for the variation from the specified conditions.
- 5.2 Vibration: (To minimize friction.) Unless otherwise specified, all tests for performance may be conducted with the instrument subjected to a vibration of 0.002 to 0.005 inch double amplitude at a frequency of 1500 to 2000 cycles per minute. The term double amplitude as used herein indicates the total displacement from positive maximum to negative maximum.
- 5.3 Vibration Equipment: Vibration equipment shall be used which will provide frequencies and amplitudes consistent with the requirements of Paragraph 3.3.4 with the following characteristics:

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- 5.3.1 Linear Motion Vibration: Vibration equipment for airframe structure mounted instruments shall be such as to allow vibration to be applied along each of three mutually perpendicular axes of the test specimen.
- 5.3.2 Circular Motion Vibration: Vibration equipment for shock mounted panel instruments shall be such that a point on the instrument case will describe, in a plane 45° to the horizontal plane, a circle the diameter of which is equal to the double amplitude specified.
- 5.4 Power Conditions: Unless otherwise specified, all tests shall be conducted at a power rating recommended by the manufacturer.
- 5.5 Position: Unless otherwise specified, all tests shall be conducted with the instrument mounted in its normal operating position.
- 5.6 Air Sample: Unless otherwise specified, the air sample shall be air containing 0.0075 per cent \pm 0.0005 per cent of carbon monoxide by volume.
6. INDIVIDUAL PERFORMANCE REQUIREMENTS: All instruments or components of such shall be subjected to whatever tests the manufacturer deems necessary to demonstrate specific compliance with this Aeronautical Standard, including the following requirements where applicable:
- 6.1 Response Time: The instrument shall be tested so that, when an air sample per Paragraph 5.6 is introduced, the alarm circuit or control circuit shall be energized within a maximum of 5 minutes.
7. QUALIFICATION TESTS: As many instruments as deemed necessary to demonstrate that all instruments will comply with the requirements of this section shall be tested in accordance with the manufacturer's recommendations.
- 7.1 Stability: The instrument shall be operated continuously for twenty-four hours at room temperature. At the end of the first and twenty-fourth hour of operation a sample of air, per Paragraph 5.6 shall be introduced into the instrument and the time required for operation of the alarm circuit or control circuit at the end of the twenty-fourth hour shall not exceed that observed at the end of the first hour of this run by more than 30 seconds and in no case shall it exceed the time specified in Paragraph 6.1.
- 7.2 Suction Variation: The instrument shall be operated continuously by varying the suction from 25 per cent below to 25 per cent above the normal rated suction. At each of these values a sample of air, per Paragraph 5.6, shall be introduced and the time required for operation of the alarm circuit or control circuit shall not differ from that observed under the normal response time test at normal rated suction, by more than \pm 30 seconds, and in no case shall it exceed the time specified in Paragraph 6.1.
- 7.3 Voltage Variations: The instrument shall be operated at any voltage within the range of Paragraph 4.4. The instrument shall then be tested with an air sample, per Paragraph 5.6, and the response time shall not vary from that at the rated by more than \pm 30 seconds, and in no case shall it exceed the time specified in Paragraph 6.1.

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- 7.4 High Temperature: The instrument shall be exposed to a temperature of 60 C, and at this temperature, the time of response shall not exceed that specified for room temperature by more than 60 seconds, and in no case shall it exceed the time specified in Paragraph 6.1.
- 7.5 Low Temperature: The instrument shall be exposed to a temperature of -65 C for a period of 48 hours, after which it shall be raised to a temperature of -55 C. After operating for thirty minutes at a temperature of -55 C, the rate of response shall not exceed the time specified at room temperature by more than 60 seconds, and in no case shall it exceed the time specified in Paragraph 6.1.
- 7.6 Humidity: The instrument shall be subjected to the conditions specified in Paragraph 3.3.2 for a period of 10 hours, after which it shall meet the requirements of Paragraph 6.1.
- 7.7 Altitude Effect: Tests shall be conducted at an altitude pressure equivalent to 25,000 feet and under these conditions the time of response shall not be increased by more than 60 seconds over sea level conditions and in no case shall it exceed the time specified in Paragraph 6.1. The instrument shall then be placed in a pressure altitude equivalent to 40,000 feet and at that pressure tested with air. No false alarm shall result.
- 7.8 Vibration: The instrument while operating normally shall be subjected to vibrations of all frequencies within the appropriate range specified in Paragraph 3.3.4 in order to determine if there exists any natural frequencies of any parts that lie within the specified range. The amplitude used may be any convenient value that does not exceed the maximum double amplitude specified in Paragraph 3.3.4 and such as not to exceed the maximum acceleration specified in Paragraph 3.3.4.

The instrument shall then be subjected to vibration at the appropriate maximum double amplitude or maximum acceleration specified in Paragraph 3.3.4 at each of the above determined natural frequencies for a period of three hours. If no natural frequencies occurred in the appropriate frequency range, the frequencies and double amplitude for this endurance test should be determined from the following table:

	<u>Cycles per Minute</u>	<u>Double Amplitude</u>
Airframe Structure Mounted	3000	.036
Shock Mounted Panel or Shock Mounted Rack	3000	.010

No damage shall be evident and the instrument shall meet the requirements of Section 6. During this time no false alarm shall be given. The time required for a response to a sample while under vibration, per Paragraph 5.6, shall not vary from that observed under normal conditions before the vibration test by more than 60 seconds, and in no case more than the time specified in Paragraph 6.1.

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- 7.9 Contamination Test: Air contaminated with 100 octane gasoline in concentration of 1000 parts per million by volume shall be passed through the instrument continuously for a period of 2 hours, after which an air sample per Paragraph 5.6 shall be passed through the instrument. The time shall not exceed that specified in Paragraph 6.1, and during the passage of the gasoline contaminated air through the instrument, no false alarms shall result. In the event that it is impractical to maintain a vapor concentration of 1000 parts per million, the length of test shall be varied in inverse proportion to the concentration for variations within ± 25 per cent of the specified concentration.

PREPARED BY SAE COMMITTEE A-4, AIRCRAFT INSTRUMENTS

